

# Physical Therapy Interventions for Patients With Osteoarthritis of the Knee: An Overview of Systematic Reviews

Gro Jamtvedt, Kristin Thuve Dahm, Anne Christie, Rikke H Moe, Espen Haavardsholm, Inger Holm, Kåre B Hagen

Patients with osteoarthritis of the knee are commonly treated by physical therapists. Practice should be informed by updated evidence from systematic reviews. The purpose of this article is to summarize the evidence from systematic reviews on the effectiveness of physical therapy for patients with knee osteoarthritis. Systematic reviews published between 2000 and 2007 were identified by a comprehensive literature search. We graded the quality of evidence across reviews for each comparison and outcome. Twenty-three systematic reviews on physical therapy interventions for patients with knee osteoarthritis were included. There is high-quality evidence that exercise and weight reduction reduce pain and improve physical function in patients with osteoarthritis of the knee. There is moderate-quality evidence that acupuncture, transcutaneous electrical nerve stimulation, and low-level laser therapy reduce pain and that psychoeducational interventions improve psychological outcomes. For other interventions and outcomes, the quality of evidence is low or there is no evidence from systematic reviews.

G Jamtvedt, PT, MPH, is Researcher, Norwegian Centre for the Health Services, PO Box 7004, St Olavs Plass, N-0130 Oslo, Norway. Address all correspondence to Ms Jamtvedt at: grj@kunnskapssenteret.no.

KT Dahm, PT, MSc, is Research Assistant, Norwegian Centre for the Health Services.

A Christie, PT, MSc, is Research Fellow, National Resource Centre for Rehabilitation in Rheumatology, Diakonhjemmet Hospital, Oslo, Norway.

RH Moe, PT, is Research Fellow, National Resource Centre for Rehabilitation in Rheumatology, Diakonhjemmet Hospital.

E Haavardsholm, MD, is Research Fellow, Department of Rheumatology, Diakonhjemmet Hospital.

I Holm, PT, PhD, is Professor, Rikshospitalet University Hospital/University of Oslo, Oslo, Norway.

KB Hagen, PT, PhD, is Researcher, National Resource Centre for Rehabilitation in Rheumatology, Diakonhjemmet Hospital.

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Osteoarthritis is the most common condition affecting synovial joints.<sup>1</sup> The prevalence of osteoarthritis increases with age, and the suffering and socioeconomic consequences are substantial. The need for clinical and cost-effective treatments is obvious.

Treatment strategies for osteoarthritis include pharmacological, non-pharmacological, and surgical interventions. In the last decade, many studies evaluating nonpharmacological treatments and physical therapy interventions have been published.

Systematic reviews of randomized controlled trials (RCTs) are considered to provide the highest level of evidence about the effectiveness of interventions. Clinicians and policy makers need evidence from systematic reviews to inform clinical practice and policy. Patients and researchers also need such information to support shared decisions and to set priorities for research. Although systematic reviews summarize the effects of a specific intervention for a specific condition, an overview of reviews (sometimes called “umbrella review”) typically summarizes evidence of many interventions for the same condition, or evidence on the same intervention for different conditions. Because the number of systematic reviews is rapidly increasing, there is a need for combining multiple reviews into overviews to provide users with easily available information. The aim of this overview is to summarize the evidence from systematic reviews on the effectiveness of physical therapy interventions for patients with osteoarthritis of the knee.

### Methods

#### Criteria for Including Reviews

We included systematic reviews published between 2000 and 2007 that examined any physical therapy intervention for patients with osteoarthritis

of the knee. We included reviews on patients with osteoarthritis in general if results from patients with knee osteoarthritis could be extracted separately. Reviews on all types of physical therapy interventions (eg, exercise, physical modalities, patient education) were included. For the purpose of this overview, we have considered pain and physical function as primary outcomes, but we also have included psychological outcomes (eg, scales of psychological disability or self-efficacy), as this information might be important to patients. The concept of “function” is based on the *International Classification of Functioning, Disability and Health* (ICF),<sup>2</sup> where “function” is an umbrella term for body function, body structure, activities, and participation. We included only reviews published in English or Scandinavian languages.

#### Search Strategy

We searched the Cochrane Library (Cochrane Database of Systematic Reviews and DARE), MEDLINE, EMBASE, and PEDro for systematic reviews published from 2000 to April 2006. In MEDLINE and EMBASE a filter based on the SIGN filters was used to identify reviews.<sup>3</sup> MESH terms and text words for osteoarthritis were entered (Appendix 1). In PEDro and the Cochrane Library, the searches were restricted to terms in the record title, abstract, or key words. In addition, we screened the reference lists of included studies. We did an updated search in the Cochrane Database of Systematic Reviews and MEDLINE in January 2007.

#### Identifying Relevant Reviews and Assessment of Methodological Quality

Two reviewers (GJ and KTD) independently assessed the relevance of all references based on abstracts, read the full text of relevant reviews, and assessed the methodological quality of included reviews using a modified version of a previously validated checklist<sup>4</sup> (Appendix 2). Nine

criteria related to search strategy, inclusion criteria, quality assessment, combining of studies, and conclusion were rated as “met,” “unclear/partly met,” or “not met.” Disagreement was resolved by discussion between the 2 reviewers. Based on a summary of these 9 criteria, an overall scientific quality of each review was labeled as “minor limitations” (at least 7 of the criteria met), “moderate limitations” (at least 4 of the criteria met), or “major limitations” (fewer than 4 of the criteria met). We excluded reviews with major limitations.

#### Data Extraction and Synthesis

One author (GJ or KTD) independently extracted data from each included review and discussed the data with the other author. Instruments and scales for assessment of methodological quality of RCTs in the reviews (eg, Jadad scale, PEDro scale) were extracted and entered into the table of characteristics of included reviews.

We applied the following criteria when we extracted data on results:

- Results for each comparison and outcome were extracted, if possible as pooled effect sizes with confidence intervals (or *P* values).
- If no direct comparison was undertaken or no quantitative pooling of data was done, the results were reported as “no quantitative pooling,” and the author’s conclusions of treatment effects were reported.
- If the results were reported inconsistently in different sections of the review, the treatment effects were extracted from the main result section.
- Inconsistency in results between reviews on the same topic was analyzed for differences in inclusion criteria, assessment of methodological quality, or methods for data synthesis.

**Table 1.**  
Quality of Evidence

Level of Quality of Evidence <sup>a</sup>	Based on:
High-quality evidence	One or more updated, high-quality systematic reviews that are based on at least 2 high-quality primary studies with consistent results
Moderate-quality evidence	One or more updated systematic reviews of high or moderate quality <ul style="list-style-type: none"> <li>● Based on at least 1 high-quality primary study</li> <li>● Based on at least 2 primary studies of moderate quality with consistent results</li> </ul>
Low-quality evidence	One or more systematic reviews of variable quality <ul style="list-style-type: none"> <li>● Based on primary studies of moderate quality</li> <li>● Based on inconsistent results in the reviews</li> <li>● Based on inconsistent results in primary studies</li> </ul>
No evidence from systematic reviews	There is no systematic review identified on this topic

<sup>a</sup> Based on principles from Grading of Recommendations Assessment, Development, and Evaluation (GRADE).<sup>5</sup>

Finally, principles from Grading of Recommendations Assessment, Development, and Evaluation (GRADE) were used to assess the quality of evidence for each outcome across reviews. GRADE is a system for grading the quality of evidence and strengths of recommendations.<sup>5</sup> The quality of evidence indicates the extent to which one can be confident that the estimate of effect is correct. High quality of the evidence means that further research is very unlikely to change our confidence in the estimate of effect.<sup>5</sup> Based on judgments considering design of primary studies, quality of primary studies, consistency (similarity of estimates of effect across studies), and directness (the extent to which comparisons, people, interventions, and outcome measures were similar to those of interest), the quality of evidence for each outcome in each main comparison was classified as “high,” “moderate,” “low,” or “no evidence from systematic reviews.” After grading the quality of evidence for each outcome in each comparison in each systematic review, the overall level of quality of the combined evidence was considered, as detailed in Table 1. In the table of overall level of quality, the following statements were used to indicate di-

rection of effect: “improves,” “reduces,” “no difference,” and “unclear.” “Unclear” also includes inconsistent evidence.

## Results

The literature search identified 1,027 relevant reviews (301 from MEDLINE, 552 from EMBASE, 114 from the Cochrane Library, and 60 from PEDro). After screening of abstracts, 49 reviews were retrieved in full text. Finally, 23 reviews fulfilled the inclusion criteria and were included in the overview. Reasons for exclusion of 26 reviews were: major limitations in methodological quality (n=4), duplicates (n=3), not a systematic review (n=10), published before the year 2000 (n=6), language restriction (n=2), and review withdrawn (n=1). Characteristics and results of included reviews are presented in Table 2.

The reviews covered the following topics: exercise, psychoeducational interventions, braces and orthoses, electromagnetic field, weight reduction, acupuncture, transcutaneous electrical nerve stimulation, low-level laser therapy, ultrasound, thermotherapy, electrical muscle stimulation, and balneotherapy. Sixteen of the reviews were of high quality (minor

limitations), and 7 reviews were of moderate quality.

## Exercise

A total of 9 reviews examined the effect of exercise on osteoarthritis of the knee. There was extensive overlap among primary studies in the reviews. A total of 113 RCTs were included in the 9 reviews, but these RCTs referred to 49 different trials only. Five reviews compared exercise with a control (home visits, telephone calls, education, or no intervention). The most updated review included 18 RCTs and concluded that exercise reduced pain.<sup>6</sup> A high-quality review conducted a meta-analysis of 17 RCTs that compared land-based exercise with a control intervention.<sup>7</sup> Overall, land-based exercise reduced pain and improved function. Both effect sizes were considered small. Subgroup analysis showed that both individual and group exercise reduced pain and improved function. The effect sizes were considered moderate.<sup>7</sup> The reviews by Pelland et al<sup>8</sup> and Petrella<sup>9</sup> confirmed these results in descriptive summaries. A meta-analysis from another updated review found that exercise did not improve psychological outcomes, but reported small to moderate effects

**Table 2.**  
Characteristics of Included Reviews<sup>a</sup>

Reference	No. of Included Studies and Participants	QR <sup>b</sup> /QPS	Results
Effectiveness of exercise interventions in reducing pain symptoms among older adults with knee osteoarthritis: a review (Focht) <sup>6</sup>	18 RCTs (N=2,320)	QR: moderate limitations QPS: not reported	No quantitative pooling, descriptive summary Author's conclusion: aerobic training, strength training, and combination of aerobic and strength training reduce pain
Chronic osteoarthritis and adherence to exercise: a review of the literature (Marks and Allegrante) <sup>14</sup>	7 RCTs (2 knee) (N=2,165)	QR: moderate limitations QPS: not reported	No quantitative pooling, descriptive summary Authors' conclusion: interventions to enhance self-efficacy, social support, and skills in long-term monitoring of process are necessary to foster exercise adherence among people with OA
Do exercise and self-management interventions benefit patients with osteoarthritis of the knee? a meta-analytic review (Devos-Comby et al) <sup>10</sup>	16 RCTs (N=2,154)	QR: moderate limitations QPS: not reported	Exercise had small to moderate effect on physical outcomes compared with control (12 RCTs, including 808 participants), pooled ES=0.29 (95% CI= 0.23 to 0.36) Exercise did not improve psychological outcomes (4 RCTs, including 530 participants), mean ES=0.04, range=-0.11-0.13 (95% CI=-0.04 to 0.13) Exercise had a small positive effect on direct measures of impairment (11 RCTs, including 740 participants), mean ES=0.15, range=0.03-0.55 (95% CI= 0.08 to 0.23) Exercise had a small positive effect on overall impact of OA (13 RCTs, including 824 participants), mean ES=0.20, range=0.04-0.88 (95% CI= 0.13 to 0.27)
Aerobic walking or strengthening exercise for osteoarthritis of the knee? a systematic review (Roddy et al) <sup>11</sup>	13 RCTs (N=2,304)	QR: minor limitations QPS: 6 studies, 3/5, range=1-3 (Jadad scale: 0-5)	Aerobic walking reduced pain (4 RCTs, including 449 participants), pooled ES=0.52 (95% CI=0.34 to 0.70), and self-reported disability (2 RCTs, including 385 participants), pooled ES=0.46 (95% CI=0.25 to 0.67), compared with control Home-based quadriceps femoris muscle strengthening reduced pain (11 RCTs, including 2,004 participants), pooled ES=0.32 (95% CI=0.23 to 0.42), and self-reported disability (11 RCTs, including 2,004 participants), pooled ES=0.32 (95% CI=0.23 to 0.41), compared with control

(Continued)

**Table 2.**  
Continued

Reference	No. of Included Studies and Participants	QR <sup>b</sup> /QPS	Results
Efficacy of strengthening exercise for osteoarthritis, part 1: a meta-analysis (Pelland et al) <sup>8</sup>	21 RCTs (18 knee) (N=2,325)	QR: minor limitations QPS: median=2, range=0-4 (out of 5)	No quantitative pooling, descriptive summary Authors' conclusion: evidence is provided for the inclusion of strengthening exercises in the rehabilitation of patients with OA to reduce pain and improve strength, function, and quality of life; there is no evidence that the type of strengthening exercise has an important impact on outcome
Efficacy of aerobic exercise for osteoarthritis, part 2: a meta-analysis (Brosseau et al) <sup>12</sup>	12 RCTs (11 knee) (N=1,363)	QR: minor limitations QPS: median=1, range=1-3 (out of 5)	No quantitative pooling, descriptive summary Authors' conclusion: aerobic exercise in various forms has beneficial effects on pain, joint tenderness, functional status, and respiratory capacity; aerobic exercise, in general, is more beneficial to patients with OA than no exercise at all and is superior or equivalent to strengthening exercises
Intensity of exercise for the treatment of osteoarthritis (Brosseau et al) <sup>13</sup>	1 RCT (N=39)	QR: minor limitations QPS: 3/5	No quantitative pooling, descriptive summary Authors' conclusion: there is no difference between high- and low-intensity stationary cycling on pain, function, gait, or $\dot{V}O_2/kg$
Exercise for osteoarthritis of the hip or knee (Fransen et al) <sup>7</sup>	17 RCTs (N=2,562)	QR: minor limitations QPS: median=3, range=2-5 (Jadad scale: 0-5)	Land-based exercise reduced pain compared with control (17 RCTs, including 2,394 participants), pooled ES=-0.39 (95% CI=-0.47 to -0.30) Individual exercise reduced pain compared with control (5 RCTs), pooled ES=-0.52 (95% CI=-0.72 to -0.32) Group exercise reduced pain compared with control (9 RCTs), pooled ES=-0.47 (95% CI=-0.60 to -0.34) Home-based exercise reduced pain compared with control (4 RCTs), pooled ES=-0.28 (95% CI=-0.40 to -0.16) Land-based exercise improved physical function compared with control (17 RCTs, including 2,562 participants), pooled ES=-0.31 (95% CI=-0.39 to -0.23)

(Continued)

**Table 2.**  
Continued

Reference	No. of Included Studies and Participants	QR <sup>b</sup> /QPS	Results
			Individual exercise improved physical function compared with control (5 RCTs), pooled ES=−0.32 (95% CI=−0.52 to −0.12) Group exercise improved physical function compared with control (9 RCTs), pooled ES=−0.39 (95% CI=−0.52 to −0.25) Home-based exercise improved physical function compared with control (5 RCTs), pooled ES=−0.32 (95% CI=−0.40 to −0.24)
Is exercise effective treatment for osteoarthritis of the knee? (Petrella) <sup>9</sup>	17 RCTs (N=unclear)	QR: moderate limitations QPS: not reported	No quantitative pooling, descriptive summary Author's conclusion: exercise had a small to moderate beneficial effect on pain compared with no treatment (4 studies); exercise had a small beneficial effect on self-reported disability compared with no treatment (6 studies); exercise had a small beneficial effect on walking speed compared with no treatment (8 studies); no evidence whether exercise improved global patient assessment compared with no treatment (2 studies)
Do exercise and self-management interventions benefit patients with osteoarthritis of the knee? a meta-analytic review (Devos-Comby et al) <sup>10</sup>	16 RCTs (N=2,154)	QR: moderate limitations QPS: not reported	Self-management programs did not improve physical outcomes compared with control (12 RCTs, including 387 participants), pooled ES=0.09 (95% CI=−0.01 to 0.19) Self-management programs had a small effect on psychological outcomes (9 RCTs, including 264 participants), mean ES=0.20 (95% CI=0.08 to 0.33) Self-management programs had no effect on direct measures of impairment (3 RCTs, including 44 participants), mean ES=0.04 (95% CI=−0.25 to 0.34) Self-management programs had a small positive effect on overall impact of OA (13 RCTs, including 387 participants), mean ES=0.11 (95% CI=0.01 to 0.21)
Meta-analyses: chronic disease self-management programs for older adults (Chodosh et al) <sup>15</sup>	53 studies (14 studies of OA)	QR: minor limitations QPS: not reported	Self-management programs reduced pain compared with control (21 comparisons from 14 studies), pooled estimate=−0.06 (95% CI=−0.10 to −0.02)

(Continued)

**Table 2.**  
Continued

Reference	No. of Included Studies and Participants	QR <sup>b</sup> /QPS	Results
			Self-management programs improved function compared with control (916 comparisons from 12 studies). pooled estimate = -0.06 (95% CI = -0.10 to -0.02)
Effectiveness of psychoeducational interventions in osteoarthritis (Marks and Allegrante) <sup>16</sup>	17 studies with different designs, including 7 RCTs (6 knee) (N=871)	QR: moderate limitations QPS: unclear	No quantitative pooling, descriptive summary Authors' conclusion: research findings indicate that OA treatment and management may be greatly facilitated by the insightful application of interventions that reduce anxiety and foster patient understanding, coping skills, and confidence
Braces and orthoses for treating osteoarthritis of the knee (Brouwer et al) <sup>17</sup>	4 studies (N=444)	QR: minor limitations QPS: 4-6 on a Delphi score up to 10	No quantitative pooling, descriptive summary Authors' conclusion: there is "silver"-level evidence that a knee brace is better than a neoprene sleeve, which is better than no support, for reducing pain and stiffness and improving function (119 participants in 3 groups); 2 studies showed that a laterally wedged insole and a strapped insole may decrease pain, swelling, and medication needed, but a naturally wedged insole also improved some outcomes
Are foot orthotics efficacious for treating painful medial compartment knee osteoarthritis? a review of the literature (Marks and Penton) <sup>18</sup>	10 studies with different designs, including 3 RCTs (N=217)	QR: moderate limitations QPS: unclear	No quantitative pooling, descriptive summary Authors' conclusion: the data indicate a strong scientific basis for applying wedged insoles in attempt to reduce osteoarthritic pain of biomechanical origin
Pulsed electromagnetic energy treatment offers no clinical benefit in reducing the pain of knee osteoarthritis: a systematic review (McCarthy et al) <sup>19</sup>	5 RCTs (N=276)	QR: minor limitations QPS: median=4, range=3-5 (Jadad scale: 0-5)	No difference between groups was found for pain, ES=-0.66 (95% CI=-1.67 to 0.35), or function, ES=-0.70 (95% CI=-1.92 to 0.52); ES was not statistically or clinically significant for any outcomes, with the exception of function in one study, SMD=0.58 (95% CI=0.14 to 1.02)
Electromagnetic fields for the treatment of osteoarthritis (Hulme et al) <sup>20</sup>	3 RCTs (N=259)	QR: minor limitations QPS: median=4, range=4-5 (Jadad scale: 0-5)	No quantitative pooling, descriptive summary Authors' conclusion: electrical stimulation therapy had a small to moderate effect on outcomes for knee OA, all findings statistically significant, with clinical benefit ranging from 13% to 23% greater with active treatment than with placebo

(Continued)

**Table 2.**  
Continued

Reference	No. of Included Studies and Participants	QR <sup>b</sup> /QPS	Results
The effect of weight reduction in obese patients diagnosed with knee osteoarthritis: a systematic review and meta-analysis (Christensen et al) <sup>21</sup>	4 RCTs (N=454)	QR: minor limitations QPS: 3, 3, 2, 2 (Jadad scale: 0-5)	Pooled ES for pain (4 RCTs, including 417 patients)=0.20 (95% CI=0.00 to 0.39) Pooled ES for self-reported disability=0.23 (95% CI=0.04 to 0.42)
Transcutaneous electrical nerve stimulation for knee osteoarthritis (Osiri et al) <sup>23</sup>	7 RCTs (N=294)	QR: minor limitations QPS: median=3, range=1-3 (Jadad scale: 0-5)	TENS reduced pain compared with control (6 RCTs, including 264 participants), SMD=-0.45, VAS (95% CI=-0.70 to -0.20) Knee stiffness also improved significantly in the active treatment group compared with placebo (2 RCTs, including 90 participants), WMD=-5.97 cm (95% CI=-9.89 to -2.1)
A systematic review of low-level laser therapy with location-specific doses for pain from chronic joint disorders (Bjordal et al) <sup>25</sup>	11 RCTs (N=565 participants with knee OA from 5 studies)	QR: minor limitations QPS: mean=6.9, range=5-9 (PEDro scale: 0-10)	LLLT reduced pain compared with control (7 RCTs), WMD=29.8 mm on a 100-mm VAS (95% CI=18.9 to 40), 5 studies involved patients with knee OA LLLT improved health status compared with control (5 RCTs), RR of not improving=0.52 (95% CI=0.36 to 0.76), 2 studies involved patients with knee OA
Therapeutic ultrasound for osteoarthritis of the knee (Robinson et al) <sup>26</sup>	3 RCTs	QR: minor limitations QPS: 4, 1, 0 (Jadad scale: 0-5)	One study (quality score=4) compared US with placebo (N=74); no differences were found between groups for pain, WMD=1.3 on a 10-cm VAS (95% CI=-0.07 to 2.67), range of motion, WMD=-2.7° (95% CI=-15.98 to 10.58), or gait speed
Acupuncture for peripheral joint osteoarthritis: a systematic review and meta-analysis (Kwon et al) <sup>22</sup>	18 RCTs (N=1,745 participants with knee OA from 14 studies)	QR: minor limitations QPS: median=4, range=1-5 (Jadad scale: 0-5)	Manual acupuncture reduced pain compared with sham acupuncture (3 RCTs, including 407 participants, 2 studies of knee OA), SMD=0.24 (95% CI=0.01 to 0.47)
Electrical muscle stimulation for osteoarthritis of the knee: biological basis and systematic review (Marks et al) <sup>28</sup>	7 studies with different designs, including 6 RCTs (N=206)	QR: moderate limitations QPS: range=8-16 (out of 25) (Beckerman et al, 1992) <sup>c</sup>	No quantitative pooling, descriptive summary Authors' conclusion: in 6 of the 7 trials, there was a positive result for the group receiving EMS compared with the control group for different outcomes, irrespective of stimulus mode and intensity (no number reported); confidence in this conclusion is weakened by low quality of the studies

(Continued)



**Table 2.**  
Continued

Reference	No. of Included Studies and Participants	QR <sup>b</sup> /QPS	Results
Thermotherapy for treatment of osteoarthritis (Brosseau et al) <sup>27</sup>	3 RCTs (N=179 participants with knee pain)	QR: minor limitations QPS: median=2/5 (Jadad scale: 0-5)	No quantitative pooling, descriptive summary Authors' conclusion: one study (50 participants) showed significant and clinically important improvement in quadriceps femoris muscle strength for ice massage compared with placebo TENS (29% relative difference); another trial showed that ice packs decreased knee edema; ice packs reduced edema more than hot packs in the third study, WMD= 2.01 (95% CI=0.92 to 3.10)
Efficacy of balneotherapy for osteoarthritis of the knee: a systematic review (Brosseau et al) <sup>29</sup>	3 RCTs (N=160)	QR: minor limitations QPS: 2, 4, 5 (Jadad scale: 0-5)	No quantitative pooling, descriptive summary Authors' conclusion: balneotherapy (combination baths) had short-term benefits for pain relief and function

<sup>a</sup> QR=quality of review, QPS=quality of primary studies, RCT=randomized controlled trial, OA=osteoarthritis, CI=confidence interval,  $\dot{V}O_2$ =oxygen consumption, SMD=standardized mean difference, ES=effect size, TENS=transcutaneous electrical nerve stimulation, VAS=visual analog scale, LLLT=low-level laser therapy, WMD=weighted mean difference, RR=relative risk, US=ultrasound, EMS=electrical muscle stimulation.

<sup>b</sup> Assessed by Oxman and Guyatt.<sup>4</sup>

<sup>c</sup> Beckerman H, Bouter LM, van der Heijden GJMG, et al. Efficacy of physiotherapy for musculoskeletal disorders: what can we learn from research? *Br J Gen Pract.* 1993;43:73-77.

on physical outcomes.<sup>10</sup> The quality of primary studies was not reported in this review.

Three reviews compared different types of exercise or different exercise intensities. Two reviews<sup>11,12</sup> concluded that there was no difference in effect between aerobic exercise (including walking) and strengthening exercise. The conclusion was based on subgroup analysis. Another review<sup>13</sup> included one study that compared high- and low-intensity exercise (stationary cycling) and found no difference in any outcome.

Marks and Allegrante<sup>14</sup> assessed the effect of adherence to exercise. From a descriptive summary of 7 RCTs on patients with osteoarthritis (2 studies on knee osteoarthritis),

the authors concluded that interventions to enhance self-efficacy and social support are necessary to foster exercise adherence among people with osteoarthritis.

All reviews concluded that exercise reduces pain and improves physical function. The effects are considered small to moderate in both high- and moderate-quality reviews. Thus, we conclude that there is high-quality evidence that exercise improves physical function and reduces pain. The reviews did not find any effect on psychological outcomes. This is based on documentation of moderate-quality evidence (Tab. 3).

### Psychoeducational Interventions

Three reviews<sup>10,15,16</sup> summarized studies on self-management, psychoeducational interventions, and pa-

tient education. In the most updated review by Devos-Comby et al,<sup>10</sup> a meta-analysis of 12 RCTs showed no improvement in physical outcomes. Small improvements in psychological outcomes and overall impact of osteoarthritis were reported. In another meta-analysis,<sup>15</sup> the authors estimated the effect size of improvement in pain and function to equate to less than 2 mm on a 100-mm visual analog scale and to about 2 points on the Western Ontario and McMaster Universities Osteoarthritis Index. The authors concluded that these findings were not of clinical importance. The quality of primary studies was not reported in the reviews. Based on these 3 reviews, we conclude that there is moderate-quality evidence that psychoeducational interventions improve psychological outcomes, but no clinically impor-

## Physical Therapy for Patients With Osteoarthritis of the Knee

**Table 3.**  
Summary of Findings for Quality of Evidence Across Systematic Reviews

Intervention	Comparison	Results (Combined)	Quality of Evidence <sup>a</sup>
Exercise	No intervention, home visit, telephone call, education	Reduces pain	High
		Improves physical function	High
		No difference in psychological outcomes	Moderate
Weight reduction	Exercise, walking, or presentation	Improves self-reported disability	High
		Reduces pain	High
Pulsed electromagnetic energy	Placebo	No difference in pain	Moderate
		No difference in physical function	Moderate
Acupuncture	Sham, waiting list, transcutaneous electrical nerve stimulation, physical therapy	Reduces pain	Moderate
Transcutaneous electrical nerve stimulation	Placebo	Reduces pain	Moderate
		Reduces knee stiffness	Moderate
Low-level laser therapy	Placebo	Reduces pain	Moderate
Psychoeducational interventions and patient education	No intervention, standard care, attention control group, sham electrical stimulation	Improves psychological outcomes	Moderate
		No difference in pain	Moderate
		No difference in physical function	Moderate
Ultrasound	Placebo, galvanic current	Unclear	Low
Electrical stimulation Braces and orthoses Thermotherapy Balneotherapy	No intervention, placebo and other interventions	Unclear	Low
Massage Traction Magnet bracelets Tape		No included reviews	No evidence from systematic reviews

<sup>a</sup> Based on principles from Grading of Recommendations Assessment, Development, and Evaluation (GRADE).<sup>5</sup>

tant difference was found for pain or function (Tab. 3).

### Braces and Orthoses

Two reviews evaluated the effect of braces and orthoses. Brouwer et al<sup>17</sup> included 4 RCTs of low to moderate quality. Three studies evaluated the effect of different orthoses, and one study evaluated the effect of braces compared with medical treatment. The results varied. Marks and Penton<sup>18</sup> included 10 studies of different designs. Three RCTs overlapped

with studies included in the review by Brouwer et al. Both reviews concluded that braces and wedged insoles reduce pain for patients with osteoarthritis of the knee. We find the results conflicting and conclude that the effects of braces and orthoses are unclear (low-quality evidence).

### Electromagnetic Field

The effects of pulsed electromagnetic energy and electromagnetic fields were presented in 2 reviews. McCarthy et al<sup>19</sup> included 5 RCTs in

a meta-analysis and concluded that there was no difference between electromagnetic energy and a placebo for pain and function. The primary studies were of high quality. Hulme et al<sup>20</sup> concluded that electromagnetic fields reduced pain based on 3 included studies, but they did not perform a meta-analysis. We conclude that there is no difference between electromagnetic fields and placebo for pain and function. This is based on documentation of moderate-quality evidence (Tab. 3).

### Weight Reduction

One recently published review<sup>21</sup> evaluated the effect of weight reduction in patients with obesity who were diagnosed with osteoarthritis of the knee. In 4 RCTs, participants received nutrition classes and behavioral therapy, and the control groups received exercise, walking, or a presentation by a dietitian. Three studies demonstrated a significant weight loss in the intervention group. The mean weight loss was 6.1 kg. The meta-analysis reported improved self-reported disability and reduction in pain, but based on a meta-regression, the authors concluded that weight loss could not predict a significant reduction in pain score, although the *P* value for the pooled effect size was .05. A clinical effect on reduction in self-reported disability was confirmed by the meta-regression. The quality of primary studies was rated as high to moderate, and we conclude that there is high-quality evidence that weight reduction improves self-reported disability and reduces pain (Tab. 3).

### Acupuncture

Kwon et al<sup>22</sup> included 18 RCTs reporting on the effect of acupuncture for peripheral joint osteoarthritis. Fourteen studies were carried out on patients with osteoarthritis of the knee. Ten studies evaluated manual acupuncture compared with a control intervention, and 8 studies evaluated electrical acupuncture compared with sham or placebo acupuncture. Most of the control groups received sham acupuncture, but some groups were allocated to waiting lists or received transcutaneous electrical nerve stimulation or physical therapy modalities (eg, exercise). A meta-analysis including 3 RCTs (2 on the knee) reported a significant reduction in pain following acupuncture compared with sham acupuncture. Based on primary studies of moderate and high

quality with consistent results, we conclude that there is moderate-quality evidence that acupuncture reduces pain compared with a control intervention (Tab. 3). The quality is graded down to moderate because few studies included patients with knee osteoarthritis.

### Transcutaneous Electrical Nerve Stimulation

One review<sup>23</sup> compared transcutaneous electrical nerve stimulation with a placebo intervention. A meta-analysis of 6 RCTs revealed a reduction in pain after transcutaneous electrical nerve stimulation compared with the control intervention. The quality of the primary studies was moderate. Based on primary studies of moderate quality with consistent results, we conclude that there is moderate-quality evidence that transcutaneous electrical nerve stimulation reduces pain compared with a placebo intervention (Tab. 3).

### Low-Level Laser Therapy

We originally included 2 reviews on low-level laser therapy,<sup>24,25</sup> but in the updated search we found that the Cochrane Review on low-level laser therapy<sup>24</sup> was withdrawn because it needed to be updated. Thus, only one review summarizing 14 RCTs of low-level laser therapy for chronic joint disorders<sup>25</sup> is included. The meta-analysis of 7 RCTs concluded that laser therapy reduced pain and improved function compared with a placebo intervention. Two major studies in this meta-analysis did not include patients with osteoarthritis of the knee. Therefore, we graded the evidence down to moderate and conclude that there is moderate-quality evidence that low-level laser therapy reduces pain and improves function (Tab. 3).

### Ultrasound

One review<sup>26</sup> summarized the effect of ultrasound based on 3 RCTs. One high-quality study compared ultra-

sound with a placebo intervention, and 2 low-quality studies compared ultrasound with active therapy. No reduction in pain or improvement in function or range of motion were observed in the high-quality study, and the results in the other studies were unclear. Thus, we conclude that the effect of ultrasound is unclear (low-quality evidence) (Tab. 3).

### Thermotherapy

One review<sup>27</sup> included 3 RCTs on the effects of heat packs, cold packs, or ice massage. All studies had small sample sizes and low quality. The results for pain or function are not consistent, and we conclude that the effect of thermotherapy is unclear (low-quality evidence) (Tab. 3).

### Electrical Muscle Stimulation

One review of 6 RCTs<sup>28</sup> summarized the effect of electrical muscle stimulation. Some of the studies reported reduction in pain, but 3 studies had fewer than 25 participants and were of low to moderate quality. Based on one moderate-quality review with low- to moderate-quality primary studies and inconsistent results, we conclude that the effect of electrical muscle stimulation is unclear (low-quality evidence) (Tab. 3).

### Balneotherapy

One review including 3 RCTs<sup>29</sup> evaluated different types of balneotherapy. No meta-analysis was performed. At least one primary study was of low quality. The authors concluded that combination baths seem to have a short-term benefit for pain relief compared with tap water. Based on few studies and heterogeneous results, we conclude that the effect of balneotherapy is unclear (low-quality evidence) (Tab. 3).

### Other Interventions

There is no systematic review published on the effects of massage, traction, magnet bracelets, or tape for knee osteoarthritis (Tab. 3).

## Discussion

This overview of systematic reviews on physical therapy interventions for patients with osteoarthritis of the knee is based on a thorough literature search, assessment of study quality, and synthesis of findings. One extensive overview of the effectiveness of exercise therapy was published earlier,<sup>30</sup> but, to our knowledge, no overview has used our explicit and systematic method.

Given the large number of reviews included in this overview, few comparisons could be graded as high-quality evidence. Only exercise for reducing pain and improving function and weight loss for disability were supported by high-quality evidence. Acupuncture, transcutaneous electrical nerve stimulation, and low-level laser therapy for pain reduction were graded as moderate-quality evidence, although they were all close to high quality. Updating of these reviews might confirm the findings and upgrade the evidence to high quality. For other interventions and outcomes, the quality of evidence was assessed as moderate, low, or no evidence from systematic reviews. New trials are needed within these areas. For a few interventions, no systematic review was identified.

Exercise was covered in 9 reviews. Because most patients with osteoarthritis receive exercise as part of their treatment, physical therapists need updated evidence concerning type, frequency, and dose of optimal exercise. Many of the reviews concluded that both aerobic and strengthening exercise, as well as individual and group exercise, are effective in patients with knee osteoarthritis.<sup>11,12</sup> The conclusions are based on indirect comparisons and subgroup analysis and should be interpreted with caution. To answer questions of optimal type, frequency, and dose of exercise, head-to-head comparisons in which participants are ran-

domly assigned to receive different exercise modalities are highly needed. One review concluded that weight reduction decreased pain and improved self-reported disability for patients who are obese. The intervention was carried out as a nutrition class and was combined with cognitive behavioral therapy. We included this review because physical therapists may play an important role in supporting people to lose weight. Based on the high-quality evidence for weight loss and exercise, physical therapists should consider collaborating with dietitians in order to reduce pain and improve function in patients with osteoarthritis of the knee.

There are important limitations in summarizing evidence based on systematic reviews only. First, primary studies might be overlooked. Even though reviews should be updated regularly, new studies are published frequently. This overview clearly shows that several reviews need updating. Not all interventions are covered by a review, and we did not find any review on massage, traction, tape, and magnet bracelets for osteoarthritis of the knee. Second, because the reviews have limited information about the trials, the conclusions may become too broad to be useful for clinicians. We think that findings from overviews should be used primarily as a compass for deciding what type of intervention to use. With regard to how interventions should be specifically carried out, overviews may have limited value. It also is important for clinicians and policy makers not to interpret low-quality evidence as evidence of no effect. Low-quality evidence means unclear evidence, and findings should initiate more research and reviews.

It was difficult to extract data on methodological quality and results from some reviews because of poor reporting. Authors of systematic re-

views should use explicit and systematic methods for including, finding, assessing, and summarizing evidence. Although a meta-analysis cannot always be performed, a synthesis of results should be expected. Sometimes conclusions were not supported by the data presented. We often found results presented study by study and by individual forest plots, making the overall results difficult to interpret. We strongly encourage authors of systematic reviews to make a synthesis of the results instead of summarizing study by study only. In this overview, 12 out of 23 included reviews come from 2 research teams. Whether this could introduce a source of bias is difficult to estimate, but it should be kept in mind.

We included 23 reviews in this overview. Reviews on exercise contributed a lot to this by 9 included reviews. Clinical guidelines often are based on evidence from systematic reviews; therefore, we need more reviews. From 1999 to 2006, the number of included reviews in the PEDro database increased from 200 to more than 1,400.<sup>31</sup> More effort also should be put into primary research.

Physical therapy interventions might be useful for people with osteoarthritis of the knee, but for some of the interventions the effect is unclear. A survey revealed that patients with osteoarthritis of the knee are interested in, and want, alternative treatments.<sup>32</sup> The study also concluded that there was a mismatch between the amount of research and the degree of interest from consumers.<sup>32</sup> A recent systematic review of the course of functional status and pain in people with osteoarthritis of the hip and knee showed that increased muscle strength (force-generating capacity), better self-efficacy, and aerobic exercise all were protective factors in the first 3 years of osteoarthritis.<sup>33</sup> The findings

and conclusions from the present overview confirm that physical therapy is beneficial for patients with osteoarthritis of the knee, but more research is needed. Exercise, including a weight reduction program for patients who are obese, seems to be a valuable treatment option for patients with pain and functional problems due to osteoarthritis of the knee.

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**Appendix 1.**

Search Strategy

<p>EMBASE</p> <ol style="list-style-type: none"> <li>1. Systematic Review/</li> <li>2. meta analysis/</li> <li>3. metaanaly\$.tw.</li> <li>4. meta analy\$.tw.</li> <li>5. ((systematic or comprehensive or literature or quantitative or critical or integrative or evidence\$) adj2 (review\$1 or overview\$1)).tw.</li> <li>6. literature study.tw.</li> <li>7. (critical adj (appraisal or analysis)).tw.</li> <li>8. cochrane.ab.</li> <li>9. medline.ab.</li> <li>10. embase.ab.</li> <li>11. (psychlit or psychlit).ab.</li> <li>12. (psychinfo or psychinfo).ab.</li> <li>13. (cinahl or cinhal).ab.</li> <li>14. science citation index.ab.</li> <li>15. bids.ab.</li> <li>16. cancerlit.ab.</li> <li>17. reference list\$.ab.</li> <li>18. bibliograph\$.ab.</li> <li>19. hand-search\$.ab.</li> <li>20. relevant journals.ab.</li> <li>21. manual search\$.ab.</li> <li>22. selection criteria.ab.</li> <li>23. data extraction.ab.</li> <li>24. 22 or 23</li> <li>25. review.pt.</li> <li>26. 24 and 25</li> </ol>	<ol style="list-style-type: none"> <li>27. or/1-21,26</li> <li>28. editorial.pt.</li> <li>29. letter.pt.</li> <li>30. Animal/</li> <li>31. Nonhuman/</li> <li>32. 30 or 31</li> <li>33. Human/</li> <li>34. 32 not (32 and 33)</li> <li>35. or/28-29,34</li> <li>36. 27 not 35</li> <li>37. exp Osteoarthritis/</li> <li>38. osteoarthritis.tw.</li> <li>39. 37 or 38</li> <li>40. 39 and 36</li> <li>41. limit 40 to yr="2000-2006"</li> </ol> <p>MEDLINE</p> <ol style="list-style-type: none"> <li>1. Meta-analysis/</li> <li>2. meta analy\$.tw.</li> <li>3. metaanaly\$.tw.</li> <li>4. meta analysis.pt.</li> <li>5. ((systematic or comprehensive or literature or quantitative or critical or integrative or evidence\$) adj2 (review\$1 or overview\$1)).tw.</li> <li>6. literature study.tw.</li> <li>7. (critical adj (appraisal or analysis)).tw.</li> <li>8. exp Review Literature/</li> <li>9. cochrane.ab.</li> <li>10. medline.ab.</li> <li>11. embase.ab.</li> </ol>	<ol style="list-style-type: none"> <li>12. (psychlit or psychlit).ab.</li> <li>13. (psychinfo or psychinfo).ab.</li> <li>14. (cinahl or cinhal).ab.</li> <li>15. science citation index.ab.</li> <li>16. bids.ab.</li> <li>17. cancerlit.ab.</li> <li>18. reference list\$.ab.</li> <li>19. bibliograph\$.ab.</li> <li>20. hand-search\$.ab.</li> <li>21. relevant journals.ab.</li> <li>22. manual search\$.ab.</li> <li>23. selection criteria.ab.</li> <li>24. data extraction.ab.</li> <li>25. 23 or 24</li> <li>26. review.pt.</li> <li>27. 25 and 26</li> <li>28. or/1-22,27</li> <li>29. comment.pt.</li> <li>30. letter.pt.</li> <li>31. editorial.pt.</li> <li>32. animal/</li> <li>33. human/</li> <li>34. 32 not (32 and 33)</li> <li>35. or/29-31,34</li> <li>36. 28 not 35</li> <li>37. exp Osteoarthritis/</li> <li>38. limit 37 to yr="2000-2006"</li> <li>39. 36 and 38</li> <li>40. osteoarthritis.tw.</li> <li>41. 37 or 40</li> <li>42. 41 and 36</li> <li>43. limit 42 to yr="2000-2006"</li> </ol>
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**Appendix 2.**

Criteria for Assessment of Quality of the Reviews

<p>The following 9 criteria were rated as “met,” “unclear/partly met,” or “not met” according to a criteria list modified from Oxman and Guyatt<sup>4</sup>:</p> <ol style="list-style-type: none"> <li>1. Is the search strategy described in enough detail for the search to be reproducible?</li> <li>2. Was the search for evidence reasonably comprehensive?</li> <li>3. Were the criteria used for deciding which studies to include in the review reported?</li> <li>4. Was bias in the selection of articles avoided?</li> <li>5. Were the criteria used for assessing the validity of the studies that were reviewed reported?</li> <li>6. Was the validity of all of the studies referred to in the text assessed using appropriate criteria in analyzing the studies that are cited?</li> <li>7. Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?</li> <li>8. Were the findings of the relevant studies combined (or not combined) and analyzed appropriately relative to the primary question the review addresses and the available data?</li> <li>9. Were the conclusions made by the author(s) supported by the data and/or the analysis reported in the review?</li> </ol>
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